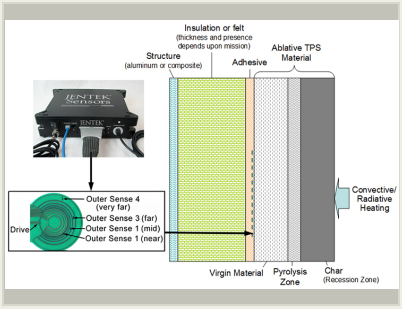
Small Business Innovation Research/Small Business Tech Transfer

Through-Thickness Health Monitoring of Thermal Protection Systems, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

This program addresses the need to monitor surface recession, temperature, and through-thickness properties of thermal protection system (TPS) materials. These TPS materials have unique properties for shedding the heat generated under reentry conditions to protect the integrity of the spacecraft. However, ever-increasing mission demands require improved performance and a better understanding for modern heat shield structures. This can be accomplished with a noninvasive, nondestructive method that uses projected sensing fields through the thickness of the TPS material. Novel eddy current methods are proposed that incorporate innovative sensor array constructs, physics-based models, and multivariate inverse methods to nondestructively assess carbon-based TPS materials such as Phenolic Impregnated Carbon Ablator (PICA). The sensors can be mounted behind the TPS material or embedded within the TPS with sensing magnetic fields that are projected through the material. JENTEK's physics-based methods for diagnostics of layered media using MWM-Array technologies have been demonstrated as a nondestructive evaluation (NDE) method for flexible and rigid ablative TPS materials for condition, orientation, and thickness assessment. These methods are commonly used for NDE, such as coating characterization, and have been extended to surface mounted sensing applications such as torque, fatigue, and heat treatment condition monitoring. This proposed Phase I will demonstrate the feasibility of these methods in an embedded sensor configuration for representative material layer configurations and a heating transient as well as investigate the adaptations required for full-scale testing and operation. JENTEK delivered the MWM-Array solution used by NASA KSC on the Space Shuttle leading edge to detect damage of the reinforced carbon-carbon (RCC) thermal protection tiles; thus JENTEK is well-positioned to deliver a novel method for health monitoring of TPS materials.



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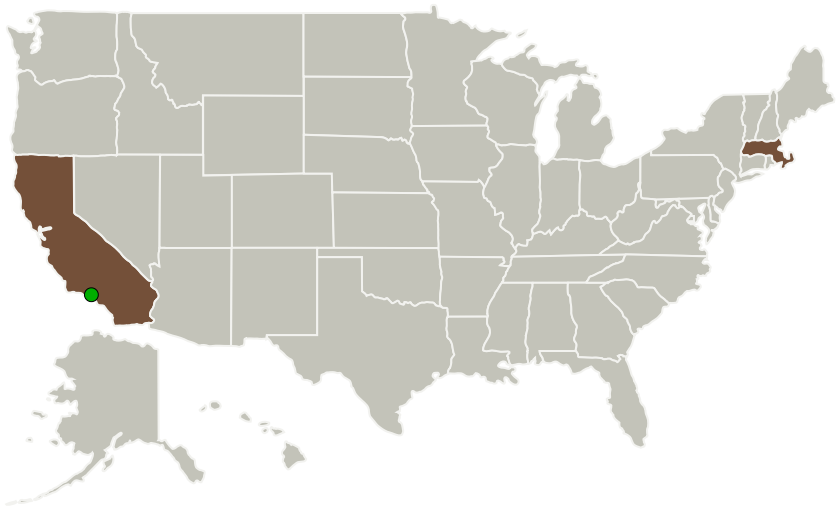
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
JENTEK Sensors, Inc.	Lead Organization	Industry	Waltham, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

June 2016: Project Start

December 2016: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139525)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

JENTEK Sensors, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

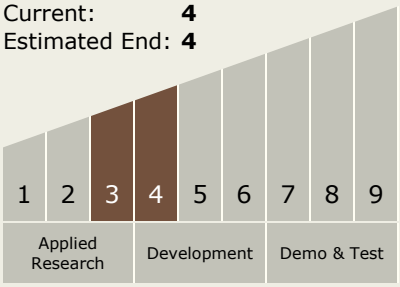
Carlos Torrez

Principal Investigator:

Andrew Washabaugh

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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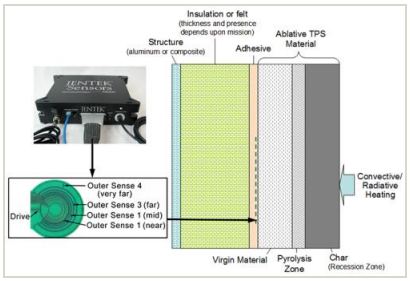
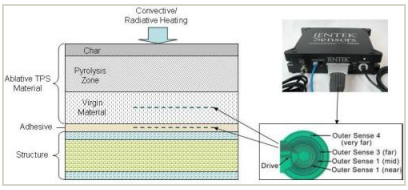
Images



Briefing Chart Image
Through-Thickness Health Monitoring of Thermal Protection Systems, Phase I *(https://techport.nasa.gov/image/126705)*



Final Summary Chart Image
Through-Thickness Health Monitoring of Thermal Protection Systems, Phase I Project Image *(https://techport.nasa.gov/image/129024)*

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.6 Instrumentation and Health Monitoring for EDL

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System